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APPLICATION NUMBER: ***60/549,930***
FILING DATE: ***March 05, 2004***

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No.

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
DORON	LEVITAS	TEL-AVIV, ISRAEL
ADI	SHECHTMAN	NOFIT, ISRAEL

Additional inventors are being named on the _____ separately numbered sheets *attached hereto*

TITLE OF THE INVENTION (500 characters max)

AN INCLINATION MEASURING DEVICE

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

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☐ Firm or Individual Name	ALPHAPATENT ASSOCIATES LTD.				
Address	P.O.B. 2345				
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City	BEIT SHEMESH	State		Zip	99544
Country	ISRAEL	Telephone	516-620-4572 (US)	Fax	516-620-4572 (US)

ENCLOSED APPLICATION PARTS (check all that apply)

☒ Specification *Number of* Pages 8
☒ Drawing(s) *Number of* Sheets 5
☐ Application Date Sheet. See 37 CFR 1.76
☐ CD(s), Number _____
☐ Other (specify) _____

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☒ Applicant claims small entity status. See 37 CFR 1.27.
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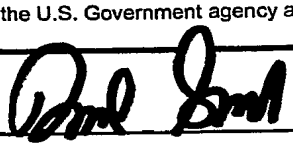
Respectfully *submitted*,

SIGNATURE 

TYPED or PRINTED NAME DANIEL J. SWIRSKY

TELEPHONE 516-620-4572 (US)

Date March 5, 2004

REGISTRATION NO. 45,148 (*if* appropriate)

Docket Number: 1301-USP

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This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer U S Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1-50. DO NOT SEND FEES OR COMPLETED ~OIRMS TO THIS ADDRESS. SEND TO: **Mail Stop Provisional Application, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Effective 1010112003. Patent fees are *subject to* annual revision.

☒ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 80.00

Complete if Known	
Application Number	
Filing Date	MARCH 5, 2004
First Named Inventor	Doron LEVITAS
Examiner Name	
Art Unit	
Attorney Docket No.	1301-USP

METHOD OF PAYMENT (*check all* that apply)

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FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code ($)	Small Entity Fee Code ($)	Fee Description	Fee Paid
1001 770	2001 385	Utility filing fee	80.00
1002 340	2002 170	Design filing fee	
1003 530	2003 265	Plant filing fee	
1004 770	2004 385	Reissue filing fee	
1005 160	2005 80	Provisional filing fee	
		SUBTOTAL(1)	($) 80.00

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

			Fee from Extra Claims below		Fee Paid
Total Claims		-20- =		X	
Independent Claims		- 3- =		X	
Multiple Dependent					

Large Entity Fee Code ($)	Small Entity Fee Code ($)	Fee Description
1202 18	2202 9	Claims in excess of 20
1201 86	2201 43	Independent claims in excess of 3
1203 290	2203 145	Multiple dependent claim, if not paid
1204 86	2204 43	** Reissue independent claims over original patent
1205 18	2205 9	** Reissue claims in excess of 20 and over original patent

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FEE CALCULATION (continued)

3. ADDITIONAL FEES

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1051 130	2051 65	Surcharge -late filing fee or oath	
1052 50	2052 25	Surcharge - late provisional filing fee or cover sheet	
1053 130	1053 130	Non-English specification	
1812 2,520	1812 2,520	For filing a request for ex parte reexamination	
1804 920*	1804 920*	Requesting publication of SIR prior to Examiner action	
1805 1,840*	1805 1,840*	Requesting publication of SIR after Examiner action	
1251 110	2251 55	Extension for reply within first month	
1252 420	2252 210	Extension for reply within second month	
1253 950	2253 475	Extension for reply within third month	
1254 1,480	2254 740	Extension for reply within fourth month	
1255 2,010	2255 1,005	Extension for reply within fifth month	
1401 330	2401 165	Notice of Appeal	
1402 330	2402 165	Filing a brief in support of an appeal	
1403 290	2403 145	Request for oral hearing	
1451 1,510	1451 1,510	Petition to institute a public use proceeding	
1452 110	2452 55	Petition to revive - unavoidable	
1453 1,330	2453 665	Petition to revive - unintentional	
1501 1,330	2501 665	Utility issue fee (or reissue)	
1502 480	2502 240	Design issue fee	
1503 640	2503 320	Plant issue fee	
1460 130	1460 130	Petitions to the Commissioner	
1807 50	1807 50	Processing fee under 37 CFR 1.17(q)	
1806 180	1806 180	Submission of Information Disclosure Stmt	
8021 40	8021 40	Recording each patent assignment per property (times number of properties)	
1809 770	2809 385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810 770	2810 385	For each additional invention to be examined (37 CFR 1.129(b))	
1801 770	2801 385	Request for Continued Examination (RCE)	
1802 900	1802 900	Request for expedited examination of a design application	

Other fee (specify) _____

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SUBMITTED BY

(Complete *(if applicable)*)

Name (Print/Type)	DANIEL J. SWIRSKY	Registration No. (Attorney/Agent)	45,148	Telephone	516-620-4572 (US)
Signature				Date	MARCH 5, 2004

AN INCLINATION MEASURING DEVICE

FIELD OF THE INVENTION

The present invention relates to an inclination measuring device, and more particularly to an inclination tracking device including means for mapping the degree of inclination and rotation of an object.

BACKGROUND OF THE INVENTION

It is often desirable to measure the degree of inclination of the object. It is especially important in the medical field, for example in measuring the degree of trunk inclination in patients having scoliosis. In order to avoid the over-referral of patients who may have scoliosis, it is common to use a scoliosis screening device (commonly known as a "Scoliometer"), such as that described in US Patent No: 5,181,525, to determine the angle of trunk rotation. The angle of trunk rotation is defined as: "the angle between the horizontal and a plane across the posterior trunk at the point or points of maximum deformity."

Scoliosis refers to a lateral spinal curve of a certain degree that affects a large number of people. A contour mapping system and method for mapping the contour of an object such as a person's spine is described in US Patent No: 6,524,260 assigned to the applicants of the present invention. US Patent No: 6,524,260 describes a diagnostic system and method which avoids the risk of radiation exposure and which is capable of providing more detailed information about the examined spine, such as the degree of curvature of the spine, or the degree of rotation of any particular vertebra therein. The mapping of the curvature of a person's spine enables the presence and severity of a deformation in the spine, such as scoliosis or Kyphosis to be detected.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding, the invention will now be described, by way of example only, with reference to the accompanying drawings in which like numerals designate like components throughout the application, and in which:

Fig. 1 is a schematic illustration of the inclination measuring device, constructed and operative in accordance with an embodiment of the present invention;

Fig. 2 is a side elevational view of a patient, whose angle of trunk rotation is being measured;

Fig. 3 is a view of the vertebrae of a spine;

Fig. 4 is a graphical illustration of the results of the measurements of a trunk rotation, using the device of Fig. 1; and

Fig. 5 is a schematic illustration of the inclination measuring device, constructed and operative in accordance with a further embodiment of the present invention.

DESCRIPTION OF THE INVENTION

The applicants have realized that it would be advantageous to be able to automatically or semi-automatically measure the angle of inclination of an object degree of rotation of a deformity of a person's back, for example. The applicants have further realized that it would be advantageous to be able utilize a contour mapping system to map and graphical output the results of the measurement of the angle of inclination. A contour mapping system is described in US Patent Nos: 6,500,131 and 6,524,260, assigned to the applicants of the present invention, the contents of which are incorporated herein.

In one embodiment of the invention, a non-invasive, automatic or semi-automatic system and method to measure the degree of rotation of a deformity of the back found on routine spinal examination is provided.

Reference is now made to Fig. 1, which is a schematic illustration of an inclinometer (or inclination measuring device), generally designated 10, which is constructed and operative in accordance with an embodiment of the present invention. The inclinometer 10 comprises an inclination tracking device 12 suitably attached to a sensor probe 14.

The inclination tracking device 12 comprises a substantially rectangular element 16 having an indentation or semi-circular arch 20 formed in the center of one edge of element 16. The arch is configured to pass over the spinal column. In one embodiment of the invention, the arch 20 may be approximately 3cm in diameter. The inclinometer 10 comprises a pair of tracking devices 22a, 22b attached on either side of the arch 20, along the bottom edge of element 16. The tracking devices 22a, 22b provide stability and allow the inclination tracking device 12 to stay on track and glide over the back. In an exemplary embodiment of the

invention, small wheels may be fitted to the tracking devices 22a, 22b. In an exemplary embodiment of the invention, the inclinometer 10 may be formed from non-warp, lightweight and hygienic material.

The sensor probe 14 may be configured to be removable from the inclinometer 10. In one embodiment of the invention, the sensor probe 14 is configured to be attached to a person's finger.

The spinal curve is sensed in the described preferred embodiments by the sensor probe, which is fitted to a finger, sensing the spinous process of each vertebra.

In an embodiment of the invention, sensor probe 14 may be in communication with a position tracking system 24, which may of an electromagnetic field type, as described in US Patent No: 6,524,260.

The sensor probe 14 is configured to measure the position and inclination of the inclination tracking device 12 as it is moved along an object, such as a spine, for example. Since the position of the sensor probe 14 is fixed in relation to the inclination tracking device 12, the inclinometer 10 does not need to be calibrated each time it is used.

The tracked positions may be recorded in an input/output storage device for further processing. In addition, the output of the workstation can be transmitted via a telecommunication device to a remote location, via a telephone line, for viewing, recording, or further processing, for example.

The inclinometer 10 may be used for preventive health screening and in the orthopedic field. By using the inclinometer as an accurate automatic or semi-automatic first-level screening of school-aged children for spinal deformities, such as scoliosis and kyphosis, for

example, the school screening system can quickly and efficiently filter out children needing further testing.

Furthermore, in the orthopedic field, the inclinometer 10 may be incorporated into the contour mapping system described in US Patent Nos: 6,500,131 and 6,524, 260 (assigned to common assignees of the present application), to semi-automate the trunk rotation measurements as a part of the standard spine scan procedure.

In the exemplary application of this embodiment, the inclinometer 10 may be used to measure the trunk rotation of a patient, for example, as described hereinbelow.

Measurement of Trunk Rotation

To measure the trunk rotation of a patient, the patient should hold out his arms perpendicular to his body with palms touching while standing. The patient should then bend over as far as possible (see Fig. 2), with the emitter approximately at the level of the naval. The patient's shoulders should be approximately at the hip level (if physically possible).Trunk rotation may be measured by holding the inclinometer 10 with one hand perpendicular to the back with the indented semi-circular arch 20 over the spinous process of C7. The inclinometer 10 should then be glided over the spine (following the spine contour as closely as possible) from C7 (see fig. 3) down to S1 (start of the sacrum) The examiner should use his/her free hand to palpate gently down the spine and guide the inclinometer 10 over the spine contour.

The sensor 14 may be configured to take at least one reading per vertebrae and preferably a plurality of readings along the back contour. In an exemplary embodiment, the sensor 14 records 40 readings per second. The system is configured to output quantitative measurements (in degrees) of the maximal trunk rotation measurements in the upper thoracic, mid-thoracic, and lumbar regions. In addition the vertebral level of the trunk rotation

measurements and the direction of the inclination (that is the difference in height between left and right may also be calculated.

Since the inclinometer 10 of the present invention uses a tracking device 12 in communication with a sensor 14, the measurement of a patient's back is not dependent on the patient bending over into an almost horizontal position (the non-limiting example of Fig 2) in order to obtain accurate readings. As will be appreciated by persons skilled in the art, the inclinometer is a digital device and is capable of measuring angular deviation irrespective of the position of object being measured. Thus, accurate results of trunk rotation, for example, may be obtained from a patient in any position, which is a major advantage over prior art devices.

Fig. 4 is an exemplary graphical illustration of the results of the measurement of trunk rotation. As shown, the screen displays the X,Y,Z coordinates of readings 35 to 56 and a graphical display of these readings in Coronal, Sagittal (top right) and Apical (bottom right) views. The display also highlights the maximum inclination and location of the vertebrae in each of the upper thoracic, lower thoracic and lumbar regions. In the example shown, the maximum inclination in the upper thoracic region is 4 degrees on vertebrae T5. In the lower thoracic region the maximum inclination is 4 degrees on vertebrae T7 and in the lumbar region, the maximum inclination is 3 degrees on vertebrae L5. It will be appreciated by persons skilled in the art that computer processing techniques allow for the processing of data and for output in any format, and is not limited by the example given. In a further embodiment of the invention, as shown in Fig. 5, to which reference is now made, the inclination tracking device 12 may be used as a stand-alone device. As will be appreciated by persons skilled in the art, the inclination tracking device 12 and sensor probe 14 may be

adapted to incorporate the storage 102 and computing capabilities 104 within the inclination tracking device 12 itself, which may also be fitted with a display screen 106. The inclination tracking device 12 may also be fitted with a transmitting device 108 for transmitting data to an external source.

In a further embodiment of the invention, the inclinometer 10 may be configured to incorporate a gyroscopic device for calculating the angles of inclination instead of a magnetic field generator of Fig. 1. Furthermore, the gyroscopic inclinometer device, which may also be utilized as a stand-alone device, may be adapted to incorporate storage and computing capabilities and be fitted with a display screen.

In a further embodiment of the invention, the inclinometer or inclination measuring device may be configured to incorporate special markers. The markers may be used in conjunction with Optical 3D tracking systems (instead of a magnetic field generator of Fig. 1.), such as infra red (IR) or other cameras, to identify and calculate the inclination angles

The above examples and description have been provided only for the purpose of illustration, and are not intended to limit the invention in any way. As will be appreciated by the skilled person, the invention can be carried out in a great variety of ways, employing more than one technique from those described above, all without exceeding the scope of the invention.

CLAIMS

1. An inclination measuring device substantially as described hereinabove.

2. An inclination measuring device substantially as illustrated in the drawings.

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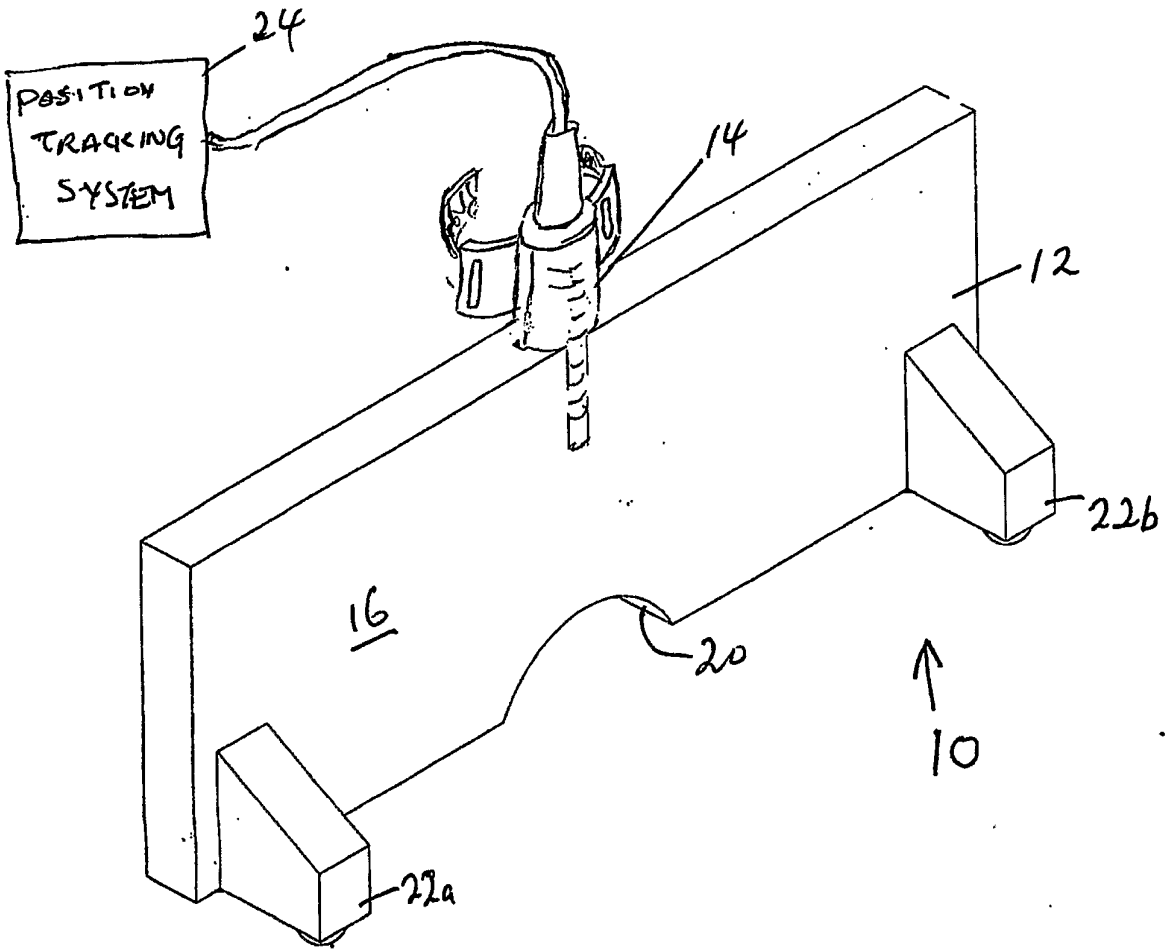

FIG. 1

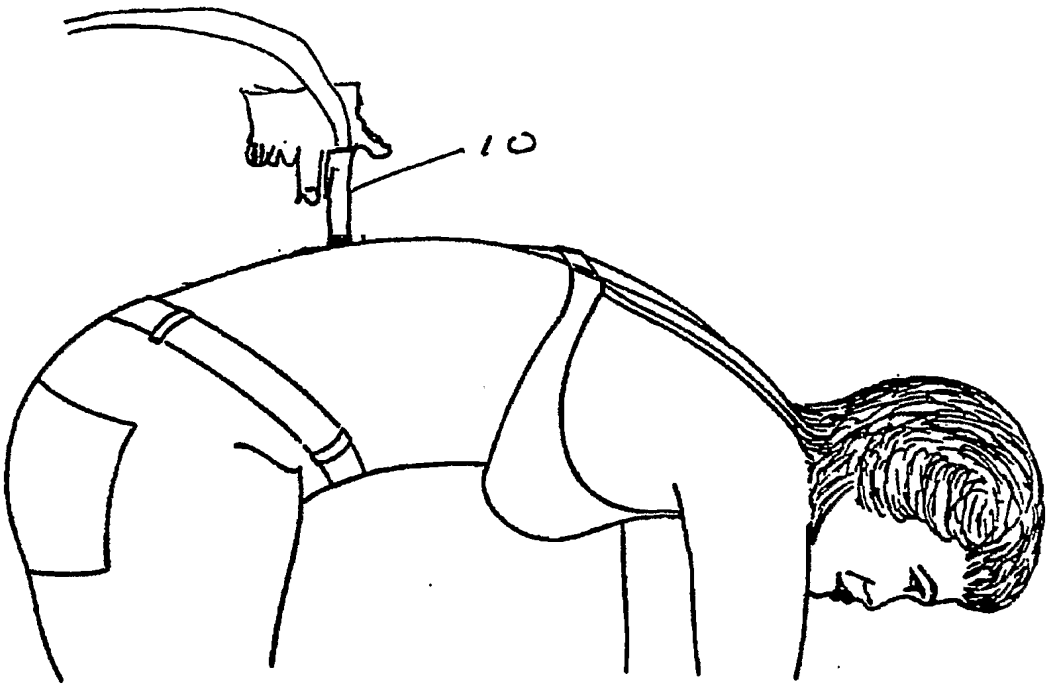

FIG. 2

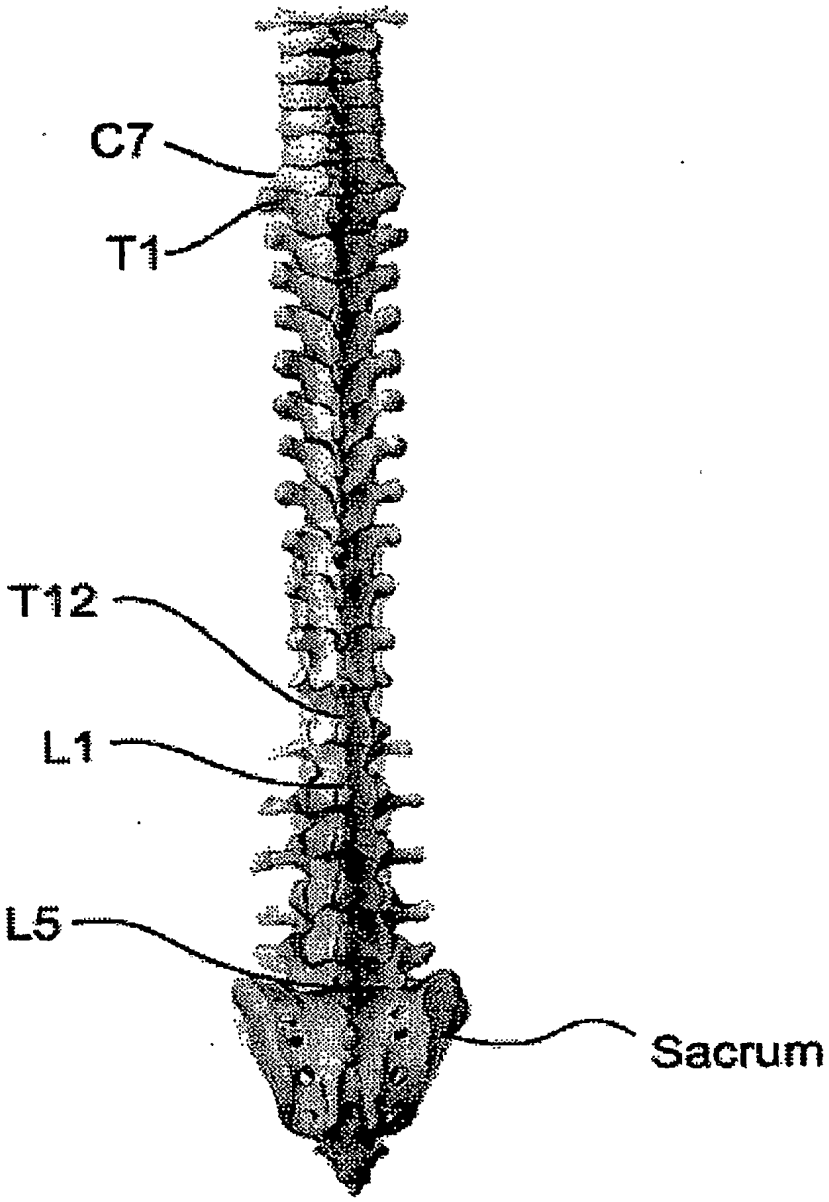

FIG 3

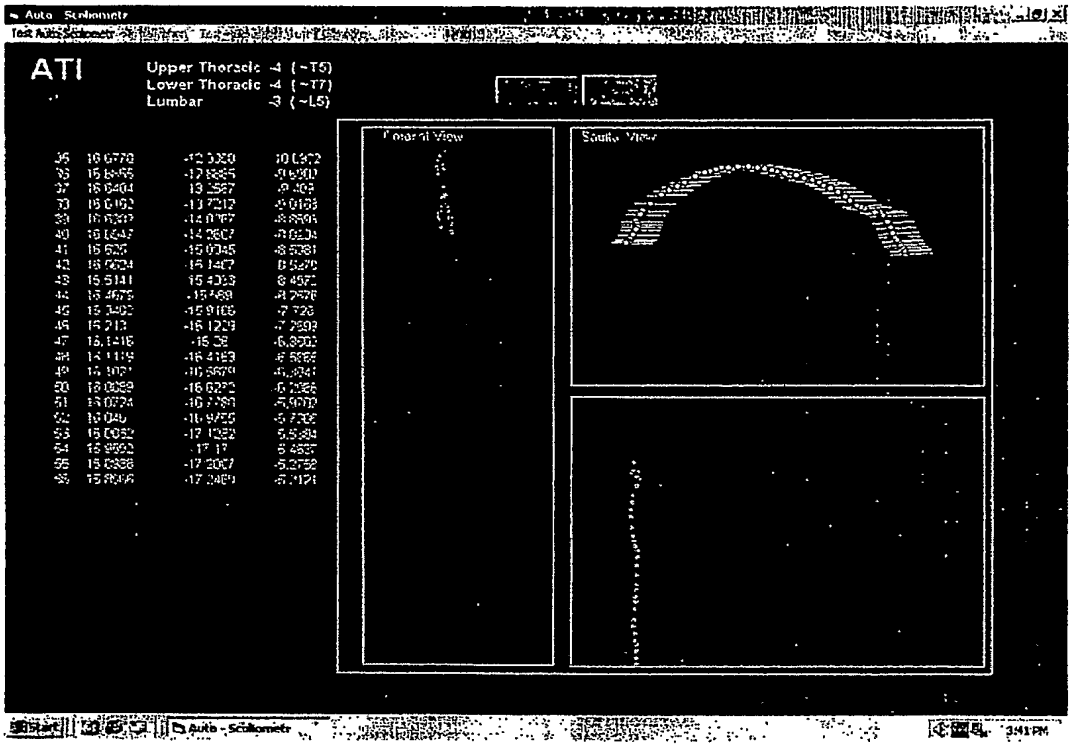

FIG. 4

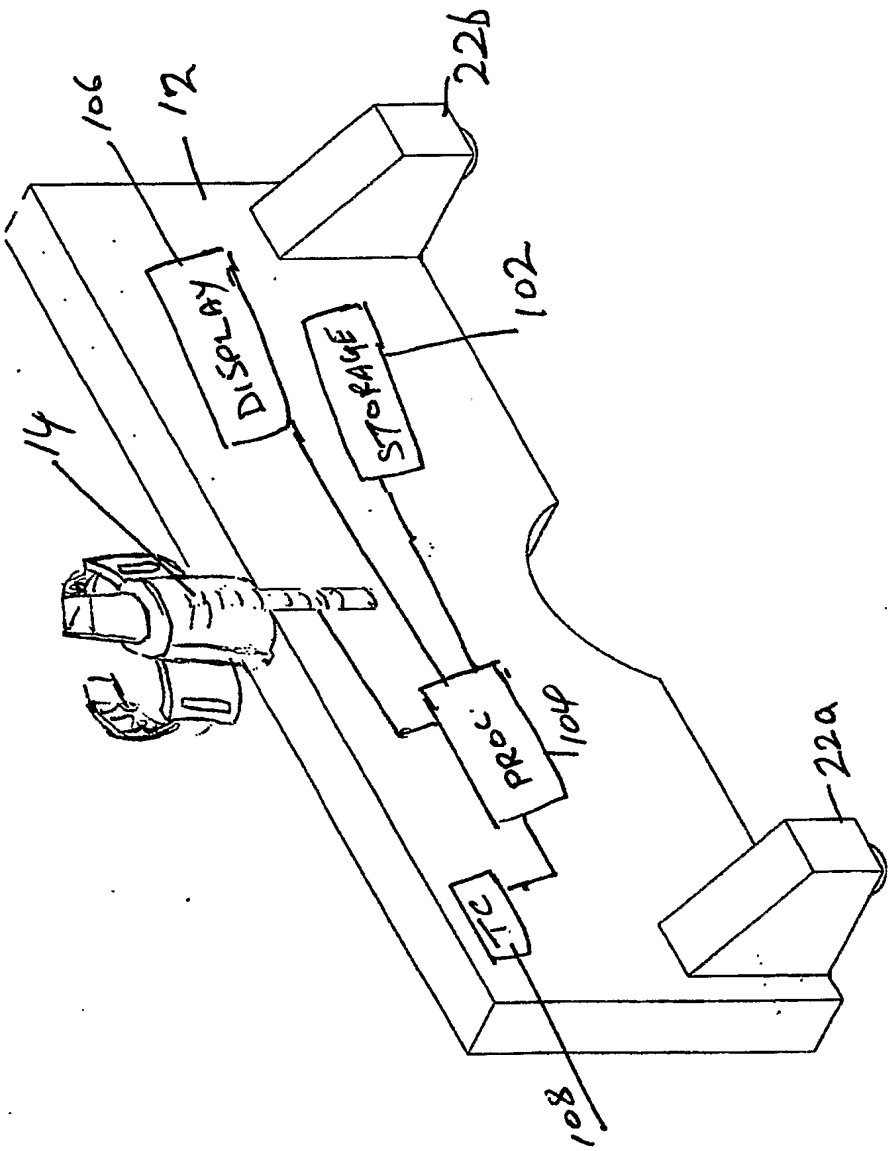

FIG. 5